



**DEPARTMENT of AGRICULTURE
and NATURAL RESOURCES**

JOE FOSS BUILDING
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**RECOMMENDATION OF CHIEF ENGINEER FOR WATER PERMIT
APPLICATION NO. 8775-3, Derrick Skogsberg**

Pursuant to SDCL 46-2A-2, the following is the recommendation of the Chief Engineer, Water Rights Program, Department of Agriculture and Natural Resources concerning Water Permit Application No. 8775-3, Derrick Skogsberg, 8248 Drop Tine Drive, Benbrook TX 76126.

The Chief Engineer is recommending APPROVAL of Application No. 8775-3 because 1) there is reasonable probability that there is unappropriated water available for the applicant's proposed use, 2) the proposed diversion can be developed without unlawful impairment of existing domestic water uses and water rights, 3) the proposed use is a beneficial use and 4) it is in the public interest as it pertains to matters of public interest within the regulatory authority of the Water Management Board with the following qualifications:

1. The well approved under Water Permit No. 8775-3 is located near domestic wells and other wells which may obtain water from the same aquifer. Water withdrawals shall be controlled so there is not a reduction of needed water supplies in adequate domestic wells or in adequate wells having prior water rights.
2. The well authorized by Permit No. 8775-3 shall be constructed by a licensed well driller and construction of the well and installation of the pump shall comply with Water Management Board Well Construction Rules, Chapter 74:02:04 with the well casing pressure grouted (bottom to top) pursuant to Section 74:02:04:28.
3. This Permit is approved subject to the irrigation water use questionnaire being submitted each year.

See report on application for additional information.

Eric Gronlund, Chief Engineer
August 16, 2023

Report to the Chief Engineer
On Water Permit Application No. 8775-3

Derrick Skogsberg

August 16th, 2023

Water Permit Application No. 8775-3 proposes to appropriate 1.78 cubic feet of water per second (cfs) from one well to be completed into the Lower Vermillion Missouri aquifer (approximately 200 feet deep) located in the approximate center of the NE ¼ Section 22 for irrigation of 160 acres located in the NE ¼ of Section 22; all in T92N-R50W. The site of interest is located approximately 9 miles east of Vermillion, SD in Union County.

AQUIFER: Lower Vermillion Missouri (LVM)

HYDROGEOLOGY:

The Lower Vermillion Missouri aquifer, referred to as the LVM aquifer for the remainder of this report, is a buried glacial outwash that was deposited by meltwater streams beyond the margin of active glacial ice (Stephens, 1967). The LVM aquifer materials range in size from a coarse sand to a coarse gravel (Niehus, 1994). The LVM aquifer is primarily confined but can be locally found under unconfined conditions such as in the flood plain of the Vermillion River (Niehus, 1994; Stephens, 1967). The LVM aquifer has an average thickness of approximately 99 feet in Union County (Niehus, 1994). Table 1 shows the information related to the areal extent of the LVM aquifer, the area utilized for this report is approximately 106,000 acres (Mathiowetz, 2018).

Table 1. Estimated areal extent for the historic LVM aquifer boundary (Hedges and others, 1982), the portion of the UVM:S aquifer that overlies the historic LVM aquifer boundary (Buhler, 2014). The current LVM aquifer boundary (Mathiowetz, 2018), and the unconfined portion of the LVM aquifer along the Vermillion River (modified from Jensen, 2000; modified from Stonesifer, 2013).

Delineation	Estimated Areal Extent (acres)
Historic Lower Vermillion Missouri Aquifer (modified from Hedges and others, 1982)	124,000
Upper Vermillion Missouri: South Aquifer (UVM:S) (modified from Buhler, 2014) - Portion that overlies LVM aquifer boundary estimated by Hedges and others, 1982.	18,000
Current Lower Vermillion Missouri Aquifer* (Mathiowetz, 2018)	106,000
Unconfined Portion of Lower Vermillion Missouri Aquifer - enclosed in UVM:S (Buhler, 2014) (modified from Jensen, 2000; modified from Stonesifer, 2013)	11,000
Unconfined Portion of Lower Vermillion Missouri Aquifer - not enclosed in UVM:S (Buhler, 2014) (modified from Jensen, 2000; modified from Stonesifer, 2013)	12,000
*Estimated by subtracting UVM:S aquifer boundary (Buhler, 2014) from historic boundary (Hedges and others, 1982)	

The LVM aquifer is hydrologically connected to the Upper Vermillion Missouri: South (UVM:S) aquifer to the north, the Missouri: Elk Point aquifer to the south, the underlying Dakota aquifer, and the Vermillion River (Buhler, 2014; Mathiowetz, 2018; Niehus, 1994; Stephens, 1967). Hedges and others (1982) delineated a boundary between the Upper Vermillion Missouri aquifer and LVM aquifer with portions of each boundary being modified by Buhler (2014) and Mathiowetz (2018) in response to additional study of the Upper Vermillion Missouri aquifer, as shown on Figure 1.

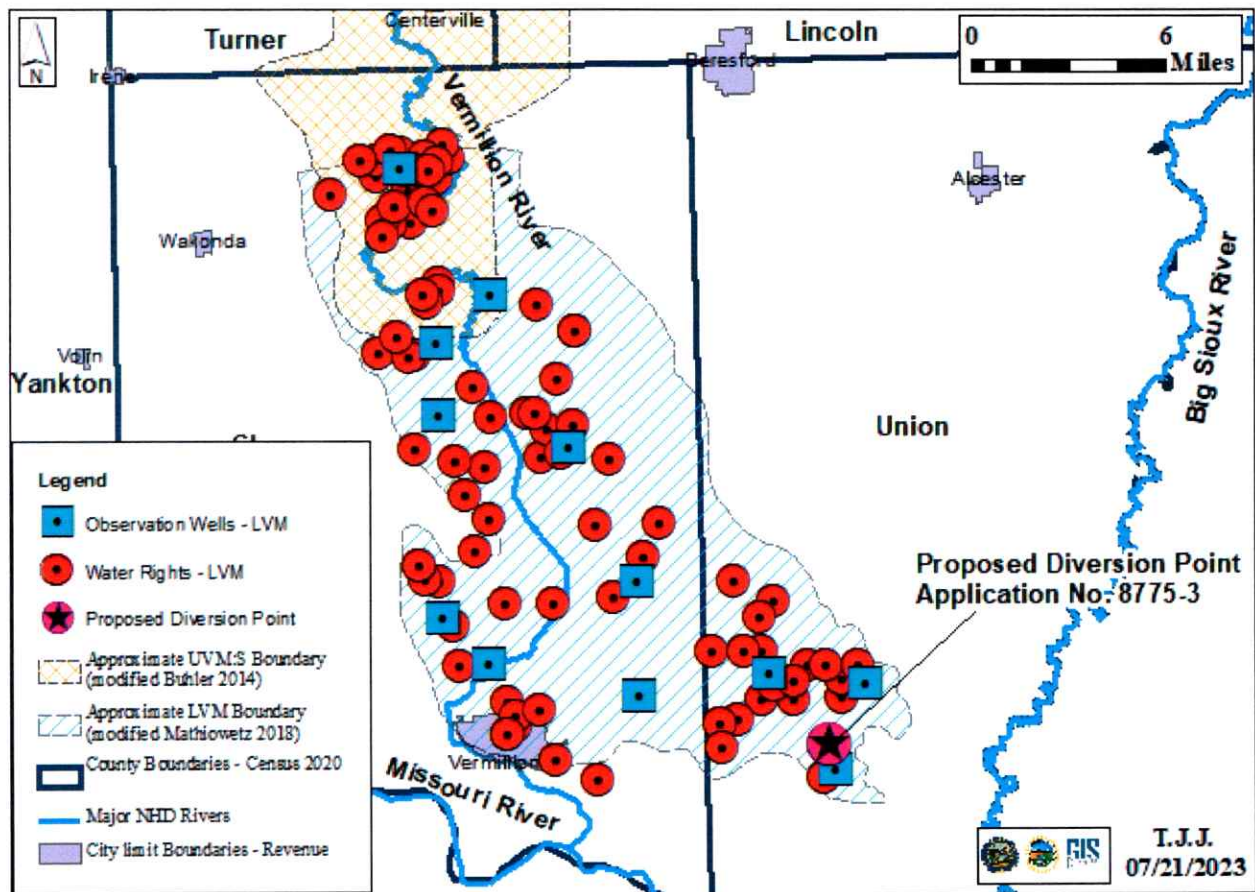


Figure 1. Map of the approximate LVM aquifer boundary delineated by Hedges and others (1982) with a portion of the UVM:S and LVM aquifer boundary estimated by Buhler (2014) and Mathiowetz (2018) respectively, and the location of proposed diversion point for Water Permit Application No. 8775-3, and LVM aquifer observation wells and water rights (Water Rights, 2023b and 2023c).

A water well completion report was not submitted with the application, so nearby completion reports will be used instead. The closest water well completed into the LVM is located 0.9 miles southwest of the proposed diversion point and was completed on October 29th, 2018 (Water Rights, 2023b). The reported depth to the top of aquifer material is 108 feet below the ground surface, the static water level is approximately 87.8 feet below the ground surface, and saturated aquifer thickness of approximately 92 feet (SDGS, 2023; Water Rights, 2023b). Based on water well completion reports near the proposed diversion point, the LVM aquifer is expected to be confined at the diversion point (SDGS, 2023; Water Rights, 2023b and 2023d).

South Dakota Codified Law (SDCL) 46-2A-9

Pursuant to SDCL 46-2A-9, "A permit to appropriate water may be issued only if there is a reasonable probability that unappropriated water is available for the applicant's proposed use, the proposed diversion can be developed without unlawful impairment of existing domestic water uses and water rights, the proposed use is a beneficial use, and the permit is in the public interest as it pertains to matters of public interest within the regulatory authority of the Water Management Board as defined by SDCL 46-2-9 and 46-2-11." This report will address the availability of unappropriated water and the potential for unlawful impairment of existing domestic uses and water rights within the LVM aquifer.

WATER AVAILABILITY:

Water Permit Application No. 8775-3 proposes to appropriate water from the LVM aquifer for irrigation use. The probability of unappropriated water being available from the aquifer can be evaluated by considering SDCL 46-6-3.1, which requires "No application to appropriate groundwater may be approved if, according to the best information reasonably available, it is probable that the quantity of water withdrawn annually from a groundwater source will exceed the quantity of the average estimated annual recharge of water to the groundwater source. An application may be approved, however, for withdrawals of groundwater from any groundwater formation older than or stratigraphically lower than the greenhorn formation in excess of the average estimated annual recharge for use by water distribution systems." The LVM aquifer is not older than or stratigraphically lower than the Greenhorn Formation, and the applicant's proposed use is not for use in a water distribution system as defined by SDCL 46-1-6(17). Therefore, the average annual recharge and average annual withdrawal rates to and from the LVM aquifer must be considered.

HYDROLOGIC BUDGET:

Recharge

Recharge to the LVM aquifer is received primarily through infiltration of precipitation where the aquifer is at or near land surface, groundwater inflow from the Upper Vermillion Missouri: South aquifer, seepage from Vermillion River, and leakage from the underlying Dakota aquifer (Niehus, 1994; Stephens, 1967). Using observation well analysis, Hedges and others (1985) estimated a recharge rate of 3.8 inches per year for the unconfined portion of the LVM aquifer. However, Stonesifer (2013) recalculated the recharge rate to be an estimated 4.58 inches per year using the same method but with additional observation well data. The historic unconfined area for this primarily confined aquifer is approximately 23,000 acres (Table 1; modified from Jensen, 2000; modified from Stonesifer, 2013). Therefore, the estimated average annual recharge rate for the historic unconfined portion of the LVM aquifer is approximately 8,778 acre-feet/year (based on Stonesifer, 2013 and modified from Jensen, 2000).

It is assumed that the confined portion of the LVM aquifer is hydrologically similar to the confined portion of the Upper Vermillion Missouri aquifer and recharges at a similar rate.

However, further study conducted on the Upper Vermillion Missouri aquifer concluded the Hedges and others (1985) recharge rate estimate to the confined portion of the Upper Vermillion Missouri aquifer is likely underestimated (Holmes & Filipovic, 2015; Buhler, 2014)). Using regional flow-net analysis, Hedges and others (1985) estimated the recharge rate of the, primarily confined, Upper Vermillion Missouri aquifer to be approximately 0.25 inches per year. The confined portion of the historic LVM aquifer is approximately 101,000 acres, this was found by subtracting both unconfined portions from the historic total area on Table 1. Using the Hedges and others (1985) confined recharge rate multiplied by the confined portion areal extent, the average annual recharge rate for the confined portion of the historic LVM aquifer is approximately 2,104 acre-feet per year; keeping in mind that this estimate is likely lower than the actual rate based on Holmes & Filipovic (2015) investigation and Buhler's (2014) report. Combining average annual recharge rate for both the confined and unconfined portions of the historic LVM aquifer (within the LVM aquifer within Hedges and others (1982) historical aquifer boundary minus Buhler (2014) delineation of the UVM:S aquifer boundary), the average annual recharge rate is approximately 10,882 acre-feet per year.

The unconfined area not enclosed in UVM:S for this primarily confined aquifer is approximately 12,000 acres (Table 1; modified from Jensen, 2000; modified from Stonesifer, 2013). Therefore, the estimated average annual recharge rate for the unconfined portion not enclosed in the UVM:S of the LVM aquifer is approximately 4,580 acre-feet/year (based on Stonesifer, 2013 and modified from Jensen, 2000).

The confined portion of the LVM aquifer not within the boundaries of the UVM:S (Holmes and Filipovic, 2015; Buhler, 2014) is approximately 94,000 acres, this was found by subtracting the unconfined area from the current total area on Table 1. Using the Hedges and others (1985) confined recharge rate multiplied by the confined portion areal extent, the average annual recharge rate for the confined portion of the LVM aquifer is approximately 1,960 acre-feet per year; keeping in mind that this estimate is likely lower than the actual rate based on Holmes & Filipovic (2015) investigation and Buhler's (2014) report. Combining average annual recharge rate for both the confined and unconfined portions of the LVM aquifer (within the LVM aquifer within Hedges and others (1982) historical aquifer boundary minus Buhler (2014) delineation of the UVM:S aquifer boundary), the average annual recharge rate is approximately 6,540 acre-feet per year.

Discharge

Discharge from the LVM aquifer primarily occurs through well withdrawals, seepage to surface water features, and evapotranspiration in areas where the aquifer is at or near land surface (Niehus, 1994; Water Rights, 2023d). There are 100 water rights/permits authorized to appropriate water from the LVM aquifer within the historical aquifer boundary delineated by Hedges and others (1982) (Water Rights, 2023c). However, 61 water rights/permits are in both the LVM aquifer boundary delineated by Hedges and others (1982) and the Upper Vermillion Missouri: South aquifer boundary delineated by Buhler (2014). Of the 61 water rights/permits, 29 are currently withdrawing water from the Upper Vermillion Missouri: South aquifer and are still labeled as withdrawing water from the LVM aquifer. Therefore, by excluding the 29 water

rights/permits that are withdrawing from the Upper Vermillion Missouri: South aquifer from the 100 water rights/permits, there are 71 water rights/permits authorized to appropriate water from the LVM aquifer, and one pending application, within the current aquifer boundary delineated by Mathiowetz (2018). There are no future use permits reserving water from the LVM aquifer (Water Rights, 2023c).

Table 2 summarizes 7 non-irrigation water rights/permits authorized to appropriate water from the LVM aquifer with the estimated annual use for each water right/permit as determined by their limiting diversion rate or annual volume. The data on Table 2 is broken up into two sets of water rights/permits 1) those that are located in the historic aquifer boundary by Hedges and others (1982) but not in the Upper Vermillion Missouri: South aquifer boundary delineated by Buhler (2014) and 2) water rights/permits that are located within both boundaries. The amount of water withdrawn was estimated by assuming the non-irrigation water rights/permits limited by an annual volume will withdraw their entire appropriated volume every year. It is estimated that the non-irrigation water rights/permits limited only by a diversion rate will pump at their maximum permitted diversion rate for 60 percent of the time. This is a standard method developed by the DANR-Water Rights Program for estimating average annual withdrawals by non-irrigation appropriations limited solely by diversion rate. It is likely an overestimate of water withdrawn by water rights/permits only limited by diversion rate. Water Permit No. 8745-3 is requesting 564 acre-feet of water to be appropriated for a one-time use with the following years of water use being non-consumptive by re-injecting the pumped water back into the aquifer (Water Rights, 2023c). Therefore, the average annual use for this application that will be accounted for in the hydrologic budget for the LVM aquifer will be 0 ac-ft/yr. Overall, the estimated average annual withdrawal rate for the LVM aquifer non-irrigation water rights/permits within the historic aquifer boundary (Hedges and others, 1982) is approximately 1,224.4 acre-feet/year, and approximately 48.6 acre-feet/year excluding water rights/permits that are in the Upper Vermillion Missouri: South delineation by Buhler (2014) (Table 2) (Water Rights, 2023c).

Table 2. Estimated average annual use for non-irrigation water rights/permits authorized to appropriate water from the LVM aquifer within the historic aquifer boundary by Hedges and others (1982) but not the UVM:S aquifer delineation by Buhler (2014), and non-irrigation water rights within aquifer boundary delineated by Hedges and others (1982) and Buhler's (2014) UVM:S boundary (Water Rights, 2023c).

Permit No.	Name	Uses	Status	Authorized Diversion Rate (cfs)	Authorized Annual Volume (acre-feet)	Estimated Use (acre-feet/year)
1870-3	USD FACILITIES MGMT	INS	LC	0.03	NA	13.0
6397-3	SD DEPT OF TRANSPORTATION	INS	LC	0.033	NA	14.3
8222-3	SOUTHEAST FARMERS COOP	COM	PE	0.167	18.4	18.4
8257-3	THEIN WELL CO INC	COM	PE	0.089	1	1
8479-3	KNIFE RIVER	IND	PE	0.133	1.84	1.84
					Total:	48.6
3905-3*	CLAY RURAL WATER SYSTEM INC	RWS	LC	2	NA	868.8
5979-3*	CLAY RURAL WATER SYSTEM INC	RWS	LC	2	307	307
					Total:	1175.8
					Combined Total:	1,224.4
*Within aquifer boundary delineated by Hedges and others (1982) and Buhler's (2014) UVM:S boundary						
LC Licensed Water Right, PE Water Permit, INS Institutional, COM Commercial, RWS Rural Water System						

There are 92 irrigation water rights/permits appropriating water from the LVM aquifer within Hedges and others (1982) historical aquifer boundary (Water Rights, 2023c). Irrigation water rights/permits have been typically required to report their annual usage by submitting an irrigation questionnaire since 1979. However, due to changes in farming practices, new equipment, and an increase in the number of permits from 43 in 2006 to 71 in 2013, the average over the entire period of record may not be an accurate reflection of average annual irrigation withdrawal at the present time. The average annual withdrawal rate for the LVM aquifer within Hedges and others (1982) historical boundary for irrigation water rights/permits that have reported over the past ten years of record (2012 to 2021) is approximately 3,015 acre-feet per year (Table 3) (Water Rights, 2023a).

There are 63 irrigation water rights/permits appropriating water from the LVM aquifer within Hedges and others (1982) historical aquifer boundary excluding rights/permits within delineation UVM:S aquifer by Buhler (2014) (Water Rights, 2023c). However, due to changes in farming practices and an increase in the number of permits from 27 in 2006 to 45 in 2013, the average over the entire period of record may not be an accurate reflection of actual average annual withdrawal at the present time. The average annual withdrawal rate for the LVM aquifer irrigation water rights/permits that have reported over the past ten years of record (2012 to 2021) is approximately 1,866 acre-feet per year (Table 3) (Water Rights, 2023a).

Along with this pending application, there are fourteen irrigation water permits approved in 2022 and early 2023 (Nos. 8632-3, 8589-3, 8641-3, 8672-3, 8680-3, 8692-3, 8693-3, 8711-3, 8725-3, 8726-3, 8731-3, 8746-3, and 8747-3) that were not included in the irrigation questionnaire compilation and need to be accounted for. The new permits are authorized to irrigate 1,479 acres, while this pending application and Application No. 8760-3 propose to irrigate approximately 332 acres. All together a total of 1,811 acres are planned to be irrigated (Water Rights, 2023c).

Assuming one foot of water per acre per year, the withdrawal rate for these water permits/applications is approximately 1,811 acre-feet per year. The average annual withdrawal rate for irrigation appropriations from 2012 to 2021 (Table 3) combined with 2022 and 2023 permits and new applications within Hedges and others (1982) historical aquifer boundary, is approximately 4,826 acre-feet per year (Water Rights, 2023a). The average annual withdrawal rate for irrigation appropriations from 2012 to 2021 (Table 3) combined with 2022 and 2023 permits and new applications within Hedges and others (1982) historical aquifer boundary excluding water rights/permits within delineation UVM:S aquifer by Buhler (2014), is approximately 3,677 acre-feet per year (Water Rights, 2023a).

There are domestic wells completed into the LVM aquifer that do not require a water right/permit, so the withdrawal amount from those wells is unknown (Water Rights, 2023d). Due to their relatively low diversion rates, withdrawals from domestic wells are not considered to be a significant portion of the hydrologic budget. Additionally, with the development of rural water systems in areas where the LVM aquifer is the uppermost aquifer available, it is likely some domestic users may have transitioned to rural water. Therefore, the quantity of water withdrawn by domestic wells is estimated to be negligible to the hydrologic budget for the LVM aquifer.

Table 3. Reported irrigation uses from the LVM aquifer for water right/permits within the historical boundary of LVM aquifer (Hedges and others, 1982) and the historical boundary of LVM aquifer excluding the delineation of the UVM:S aquifer (Buhler, 2014) (Water Rights, 2023a)

Historical Boundary of LVM aquifer (Hedges and others, 1982)			Historical Boundary of LVM aquifer (Hedges and others, 1982), Excluding UVM:S Aquifer Boundary (Buhler, 2014)		
Year	Number of Permit/License	Annual Pumpage (ac-ft/yr)	Year	Number of Permit/License	Annual Pumpage (ac-ft/yr)
1979	49	1163.0	1979	40	810.5
1980	47	2417.0	1980	38	1995.0
1981	49	1543.0	1981	39	1205.4
1982	37	870.0	1982	27	758.3
1983	38	716.3	1983	28	644.7
1984	47	691.0	1984	37	549.0
1985	46	1328.2	1985	36	927.2
1986	45	1047.5	1986	35	807.5
1987	37	1115.4	1987	27	794.4
1988	38	2083.8	1988	28	1442.4
1989	38	2301.2	1989	28	1522.2
1990	38	2113.2	1990	28	1288.2
1991	39	1670.1	1991	29	1044.1
1992	39	168.8	1992	29	116.7
1993	39	0.0	1993	29	0.0
1994	39	517.3	1994	29	308.7
1995	37	506.6	1995	28	368.2
1996	36	997.6	1996	27	572.9
1997	36	1085.0	1997	27	645.0
1998	36	1032.9	1998	26	736.6
1999	38	900.6	1999	27	698.9
2000	38	2041.7	2000	27	1574.9
2001	38	2037.0	2001	27	1781.8
2002	40	1762.3	2002	29	1123.2
2003	40	1800.6	2003	29	1470.6
2004	39	1747.5	2004	28	1167.6
2005	45	1410.2	2005	28	1071.1
2006	43	2674.5	2006	27	1734.3
2007	50	2909.1	2007	26	1327.0
2008	55	4301.3	2008	28	911.9
2009	58	482.6	2009	30	460.8
2010	59	144.6	2010	30	134.0
2011	62	2195.1	2011	33	1219.4
2012	61	7759.5	2012	33	3355.3
2013	71	4109.1	2013	45	2856.5
2014	75	1576.3	2014	48	1006.4
2015	78	1925.8	2015	50	1473.5
2016	79	2187.5	2016	51	1779.0
2017	79	3156.6	2017	52	2439.3
2018	79	427.7	2018	52	419.4
2019	79	339.6	2019	52	333.0
2020	78	3353.2	2020	51	1972.5
2021	80	5316.2	2021	54	3026.7
Average 1979-2021		1812.2	Average 1979-2021		1159.9
Average 2012-2021		3015.2	Average 2012-2021		1866.2

Hydrologic Budget Summary

The average annual recharge rate for the unconfined portion of the historic LVM aquifer (Buhler, 2014) is approximately 8,778 acre-feet/year. The average annual recharge rate for the historic confined portion LVM aquifer (Mathiowetz, 2018) is approximately 2,104 acre-feet/year. Combining average annual recharge rate for both the confined and unconfined portions of the historic LVM aquifer, is approximately 10,882 acre-feet per year.

The average annual withdrawal rate from the LVM aquifer within Hedges and others (1982) historical aquifer boundary (the non-irrigation appropriations (1,224 acre-feet/year); the average annual withdrawal rate for irrigation appropriations from 2012 to 2021, 2022-2023 water permits, and pending applications, including this one, (4,826 acre-feet/year)) is approximately 6,050 acre-feet per year, also shown on Table 4 (Water Rights, 2023a).

The average annual recharge rate for the unconfined portion of the LVM aquifer not enclosed in the UVM:S aquifer (Buhler, 2014) is approximately 4,580 acre-feet/year. The average annual recharge rate for the current confined portion LVM aquifer (Mathiowetz, 2018) is approximately 1,960 acre-feet/year. Combining average annual recharge rate for both the current confined and unconfined portions of the LVM aquifer not enclosed in the UVM:S aquifer, is approximately 6,540 acre-feet per year.

The average annual withdrawal rate from the LVM aquifer within Hedges and others (1982) historical aquifer boundary excluding rights/permits within delineation UVM:S aquifer by Buhler (2014) (the non-irrigation appropriations (49 acre-feet/year); the average annual withdrawal rate for irrigation appropriations from 2012 to 2021, 2022-2023 water permits, and new applications, including this one, (3,677 acre-feet/year)) is approximately 3,726 acre-feet per year, also shown on Table 4 (Water Rights, 2023a).

Water Permit No. 8745-3 proposes a one-time use of 564 acre-feet/year with an ongoing non-consumptive use of water due to reinjection of pumped water into the aquifer. Therefore, the one-time use is not included in the average annual use because the annual use will be 0 acre-feet/year.

Collectively, the average annual recharge rate for both the confined and unconfined portions of the LVM aquifer using the Buhler (2014) and Mathiowetz (2018) delineation of the aquifer is greater than the average annual withdrawal rate from both the LVM aquifer within Hedges and others (1982) historical aquifer boundary and the LVM aquifer within Buhler (2014) and Mathiowetz (2018) boundary delineated portions of the UVM:S and LVM aquifers. Furthermore, the average annual recharge to the aquifer exceeds the average annual withdrawals plus the one-time use for Water Permit No. 8745-3. Based on the hydrologic budget, there is a reasonable probability unappropriated water is available from the LVM aquifer for the proposed appropriation.

Table 4. List of water rights/permits withdrawals, new applications (if approved), one-time use for application withdrawals, and unconfined/confined recharge from both the historic boundary of the LVM and current boundary of the LVM excluding the UVM:S delineated areas made by Buhler (2014) (Water Rights, 2023a)

	Historical Boundary of the LVM Aquifer (Hedges and others, 1982) Pumpage (ac-ft/yr)	Historic Boundary of the LVM Aquifer (Hedges and others, 1982), Excluding UVM:S Aquifer Boundary (Buhler 2014) Pumpage (ac-ft/yr)
Non-Irrigation Appropriation	1,224	49
Irrigation Appropriation (2012-2022)	3,015	1,866
New Permits (2022-2023)	1,479	1,479
Pending Applications (Including this one)	332	332
Total Withdrawal	6,050	3,726
Water Permit No. 8745-3 one-time use (2023)	564	564
Unconfined Recharge	8,778	4,580
Confined Recharge	2,104	1,960
Total Recharge	10,882	6,540

OBSERVATION WELL DATA:

Administrative Rule of South Dakota (ARSD) 74:02:05:07 requires that the Water Management Board shall rely upon the record of observation well measurements in addition to other data to determine that the quantity of water withdrawn annually from the aquifer does not exceed the estimated average annual recharge of the aquifer.

The DANR-Water Rights Program monitors ten observation wells completed into the LVM aquifer with two additional observation wells (CL-80J and CL-66AR) that are within both the historic aquifer boundary delineated by Hedges and others (1982) and Upper Vermillion Missouri: South aquifer boundary as defined by Buhler (2014), with observation wells in the area of this application shown on Figure 5 (Water Rights, 2023b). These observation wells provide data on how the aquifer reacts to regional climatic conditions and local pumping. The three closest observation wells to the diversion point are UN-77K (approximately 0.8 miles south), UN-77H (approximately 2.2 miles northeast), and UN-77I (approximately 2.8 miles northwest) (Water Rights, 2023b). The hydrographs for these observation wells are displayed in Figures 2, 3, and 4 respectively (Water Rights, 2023b). The data points utilized to construct the hydrographs are measurements of the static water level in the observation wells from the top of the well casing.

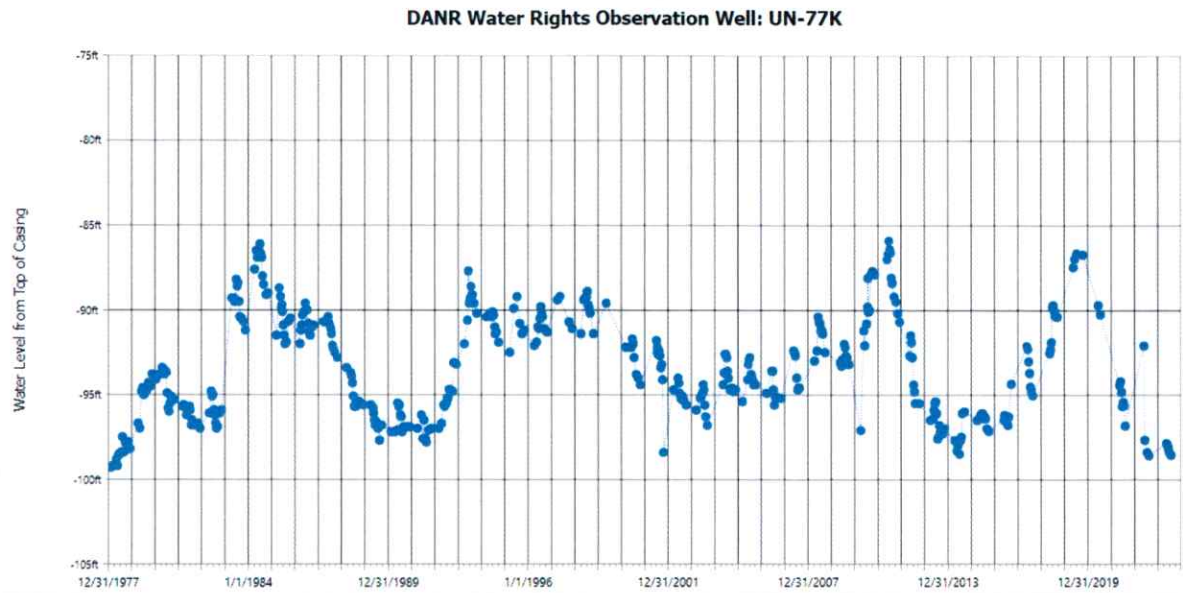


Figure 2. Hydrograph for observation well UN-77K (Water Rights, 2023b)

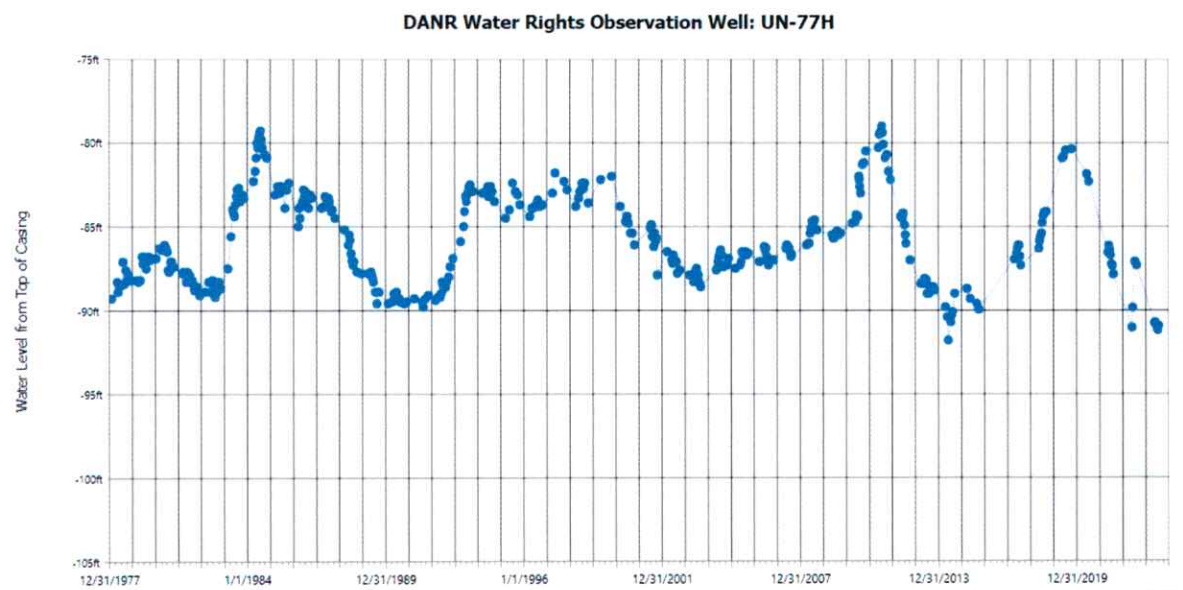


Figure 3. Hydrograph for observation well UN-77H (Water Rights, 2023b)

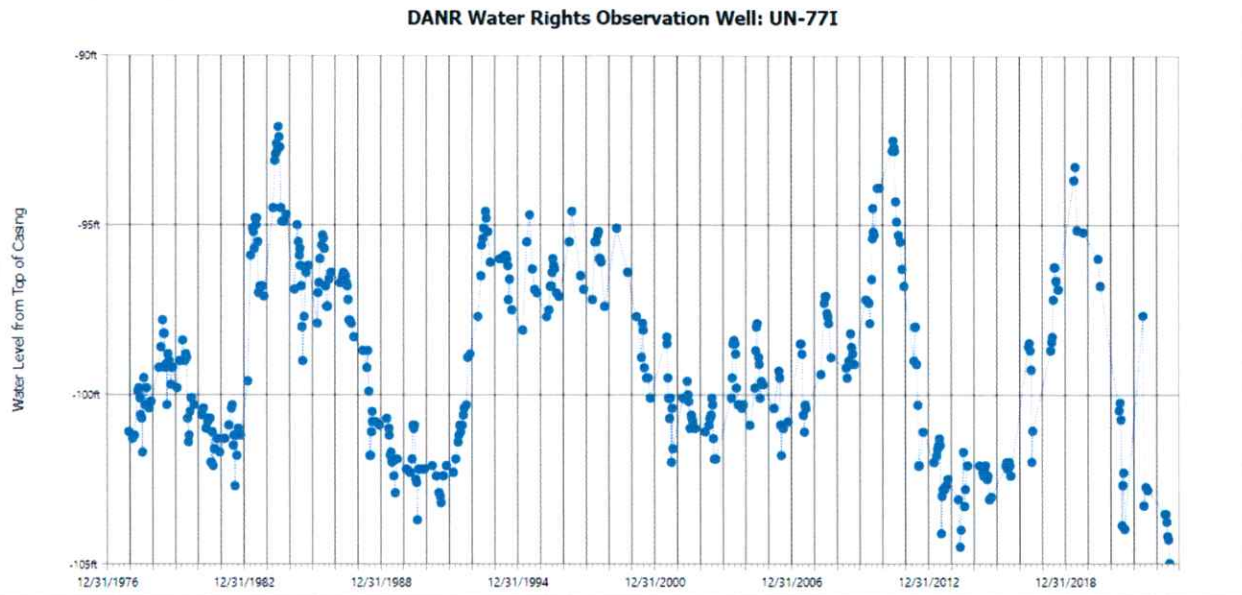


Figure 4. Hydrograph for observation well UN-77I (Water Rights, 2023b)

A majority of the observation wells in the LVM aquifer have a relatively stable trend in the water level, as seen in Figures 2 to 4. The hydrographs for the LVM aquifer observation wells indicate that the aquifer responds well to climatic conditions because water levels are rising during wetter periods (early spring snowmelt and precipitation) and declining to a stable water level during drier periods. Additionally, the water levels in the observation wells display that the amount of recharge to and natural discharge from the aquifer greatly exceeds pumping with the aquifer with water levels returning to pre-pumping conditions between irrigation seasons. Aquifer recovery indicates that climatic conditions and therefore, the effects of recharge to and natural discharges from the aquifer govern the long-term fluctuations of waters levels in the aquifer rather than the impacts of pumping from the LVM aquifer. By recognizing that both recharge to and natural discharge from an aquifer can be captured for pumping, the observation well hydrographs demonstrate unappropriated water is available for the proposed appropriation.

POTENTIAL FOR UNLAWFUL IMPAIRMENT OF EXISTING WATER RIGHTS:

Water rights/permits in the general vicinity of the proposed well site for this application are shown in Figure 5 and summarized in Table 5. The closest water right/permit to the proposed diversion point for this application, not held by the applicant, is Water Permit No. 8055-3 which is held by Tarn Vieira. The diversion point for Water Permit No. 8055-3 is located approximately 1 mile south of the proposed diversion point for this application (Water Rights, 2023c). There are domestic wells on file with the DANR-Water Rights Program that are completed into the LVM aquifer, with the closest domestic well on file (not held by the applicant) approximately 0.6 miles west of the diversion point based on the legal description provided by the well driller on the well completion report (Water Rights, 2023d). There could potentially be other domestic wells completed into the LVM aquifer near the diversion point that are not on file with the DANR-Water Rights Program.

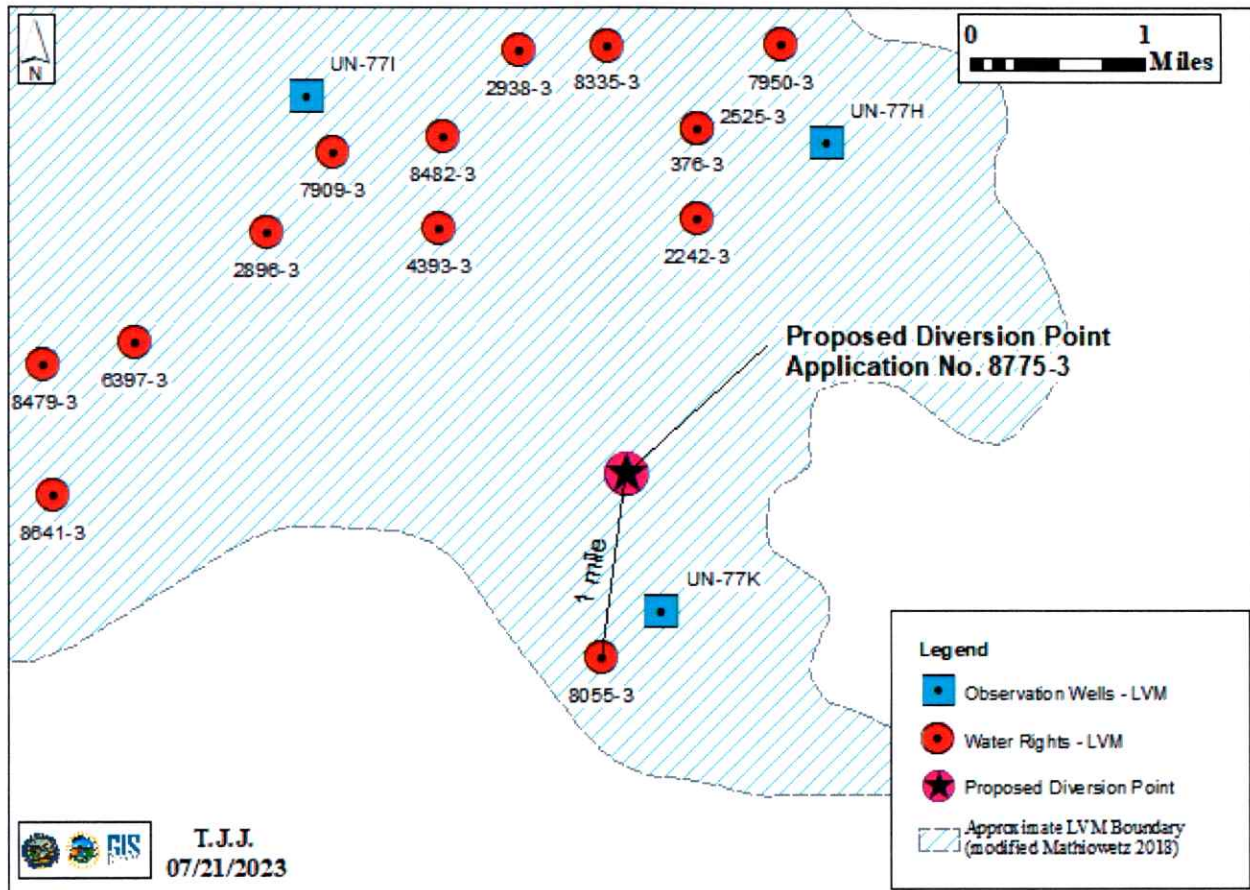


Figure 5. Map of the proposed diversion point for Water Permit Application No. 8775-3, nearby LVM aquifer water rights/permits, and observation wells within 4 miles of the proposed diversion point (Water Rights, 2023b and 2023c).

Table 5. List of water rights/permits shown in Figure 5 (Water Rights, 2023c).

Permit	Name/Business	Priority	Status	Use Type	CFS	Acres
376-3	Virginia Quam	12/26/1956	License	Irrigation	2.28	160
2242-3	Gerald B Hanson	02/03/1975	License	Irrigation	1.95	136
2525-3	Virginia Quam	02/04/1976	License	Irrigation	1.94	136
2896-3	Lyle Wagner	08/17/1976	License	Irrigation	2.23	265
2938-3	Maxxine Bird	09/07/1976	License	Irrigation	1.94	136
4393-3	Lyle A Wagner	03/01/1979	License	Irrigation	1.71	120
6397-3	SD Dept of Transportation	02/18/2003	License	Institutional	0.033	0
7909-3	Scott Wagner	09/16/2013	License	Irrigation	1.89	157
7950-3	Luverne Hanson	01/24/2014	Permit	Irrigation	1.78	150
8055-3	Tarn Vieira	09/24/2014	Permit	Irrigation	0.27	40
8335-3	Dakota Eastern Inc.	03/01/2018	Permit	Irrigation	1.84	158
8479-3	Knife River	01/15/2021	Permit	Industrial	0.133	0
8482-3	Reid Bird	01/29/2021	Permit	Irrigation	1.56	116
8641-3	Derrick Skogsberg	06/24/2022	Permit	Irrigation	1.78	160

Based on the well completion reports near the proposed diversion point for this application, the LVM aquifer is expected to be under confined conditions at the proposed well site. In a confined

aquifer, drawdown from a pumping well can extend some distance from the well. The Water Management Board recognizes that putting water to beneficial use requires a certain amount of drawdown to occur. The Board has developed rules to allow water to be placed to maximum beneficial use without the necessity of maintaining artesian head pressure for domestic use. The Water Management Board defined an “adversely impacted domestic well” in ARSD 74:02:04:20(7) as:

“A well in which the pump intake was set at least 20 feet below the top of the aquifer at the time of construction or, if the aquifer is less than 20 feet thick, is as near to the bottom of the aquifer as is practical and the water level of the aquifer has declined to a level that the pump will no longer deliver sufficient water for the well owner’s needs.”

The Water Management Board considered the delivery of water by artesian head pressure versus maximum beneficial use during the issuance of Water Right No. 2313-2 for Coca-Cola Bottling Company of the Black Hills. The Board adopted the Findings of Facts and Conclusions of Law that noted the reservation of artesian head pressure for delivery of water would be inconsistent with SDCL 46-1-4 which states, “general welfare requires that the water resources of the state be put to beneficial use to the fullest extent of which they are capable...” (Water Rights, 1995). Furthermore, the Water Management Board found if increased cost or decreased production as a result of impacts on artesian head pressure by legitimate users is to be considered as an unlawful impairment, it would also conflict with SDCL 46-1-4 (Water Rights, 1995). With that in mind, some existing well owners may need to install or lower pumps depending on the specific characteristics of the LVM aquifer at their location. However, when considering the statutes (SDCL 46-1-4 and 46-6-6.1), rules (ARSD 74:02:04:20(6) and (7)), history of irrigation in the area without any complaints of well interference (Water Rights, 2023e), and the saturated aquifer thickness near the diversion point, any drawdown created from the diversion is not expected to cause an unlawful impairment on existing water right/permit holders or domestic users with adequate wells. Therefore, there is a reasonable probability that any interference from the proposed appropriation will not impose unlawful impairments on existing users with adequate wells.

CONCLUSIONS:

1. Water Permit Application No. 8775-3 proposes to appropriate 1.78 cfs from one well to be completed into the Lower Vermillion Missouri aquifer (approximately 200 feet deep) for irrigation of 160 acres. The site of interest is located approximately 9 miles east of Vermillion, SD in Union County.
2. Based on observation well data and the hydrologic budget, there is a reasonable probability that unappropriated water is available from the LVM aquifer to supply the proposed appropriation.

3. There is a reasonable probability that the diversion by Water Permit Application No. 8775-3 will not unlawfully impair adequate wells for existing water rights/permits and domestic uses.



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References

- Buhler, K. A. 2014. Report to the Chief Engineer on 21 Water Permit Applications from the Upper Vermillion Missouri Aquifer. SD DANR – Water Rights Program, Joe Foss Bldg. Pierre, SD.
- Hedges, L.S., Allen, J., Holly, D.E., 1985. Evaluation of Ground-Water Resources Eastern South Dakota and Upper Big Sioux River, South Dakota and Iowa, Task 7: Ground Water Recharge; United States Army Corps of Engineers Contract DACW 45-80-C-0185.
- Hedges, L.S., Burch, S.L., Iles, D.L., Barari, R.A., and Schoon, R.A. 1982. Evaluation of Ground-Water Resources Eastern South Dakota and Upper Big Sioux River, South Dakota and Iowa, Task 1: Bed rock Topography and Distribution, Task 2: Extent of Aquifers, Task 3 Ground-Water Storage, Task 4: Computerized Data Base. United States Army Corps of Engineers Contract DACW 45-80-C-0185.
- Holmes, S.L., Filipovic, D. 2015. Hydrogeologic Investigation of the Upper-Vermillion-Missouri Aquifer. Open File Report 93-UR. Akeley-Lawrence Science Center, University of South Dakota. Vermillion, SD.
- Jensen, A.R., 2000. First Occurrence of Aquifer Materials in Clay County, South Dakota. SD DANR-Geological Survey Aquifer Materials Map 1. Vermillion, SD.
- Mathiowetz, A. 2018. Report to the Chief Engineer on Water Permit Application 8335-3. Natural Resource Engineer IV, SD DANR – Water Rights Program, Joe Foss Bldg. Pierre, SD.
- Niehus, C.A., 1994. Water Resources of Lincoln and Union Counties, South Dakota. U.S. Geological Survey Water-Resources Investigations Report 93-4195. U.S. Geological Survey. Rapid City, SD.

SDGS, 2023. South Dakota Geological Survey Lithologic Logs Database. Accessed June 26, 2023. <http://cf.sddanr.net/lithdb/>.

Stephens, J.C., 1967. Geology and Water Resources of Clay Counties, South Dakota Part II: Water Resources. Bulletin 19. SD DANR-Geological Survey, Vermillion, SD.

Stonesifer, J. R. 2013. Report to the Chief Engineer on Water Permit Application 7918-3. SD DANR – Water Rights Program, Joe Foss Bldg. Pierre, SD.

Water Rights, 1995. Findings of Fact, Conclusions of Law, and Final Decision in the Matter of Water Permit Application No. 2313-2, Coca-Cola Bottling Company of the Black Hills. DANR-Water Rights Program file for Water Right No. 2313-2. Pierre, SD.

Water Rights, 2023a. "1979-2021 Irrigation Summaries by Aquifer", SD DANR-Water Rights Program, Joe Foss Building, Pierre, SD.

Water Rights, 2023b. Observation Well Data, SD DANR-Water Rights Program, Joe Foss Bldg, Pierre, SD.

Water Rights, 2023c. Water Right/Permit Files, SD DANR-Water Rights Program, Joe Foss Bldg, Pierre, SD.

Water Rights, 2023d. Well Completion Reports, SD DANR-Water Rights Program, Joe Foss Bldg, Pierre, SD.

Water Rights, 2023e. County Files, SD DANR-Water Rights Program, Joe Foss Bldg, Pierre, SD.